1985 Insect Pest Management Guide

FIELD and FORAGE CROPS

You must be certified as a pesticide applicator to use restricted-use pesticides.
See your county Extension adviser in agriculture for information.

FEDERAL AND STATE LAWS

The U.S. Environmental Protection Agency is classifying pesticides for "general" or "restricted" use. Only a few pesticides have been classified (Table 1).

Commercial applicators who apply restricted-use pesticides must be certified. Commercial applicators include persons applying a pesticide for hire and governmental personnel, chemical company representatives, and others involved in demonstrational, regulatory, and public health pest control. Certification as a commercial applicator requires passing a written examination administered either by the Illinois Department of Agriculture or the Department of Public Health.

Private applicators who use restricted-use pesticides "for the purpose of producing any agricultural commodity on property owned or rented by him or as exchange labor (no compensation) on the property of another" must also be certified, either by attending an educational training program or by passing an examination.

Educational training programs for farmers (private applicators) and commercial pesticide applicators are conducted by the Cooperative Extension Service to prepare persons for certification. For additional information, consult your county Extension adviser in agriculture. The actual certification and the issuing of permits or licenses are handled by the Illinois Department of Agriculture or the Illinois Department of Public Health.

Insecticides and Classifications

At the time this publication was in preparation, only a few of the insecticides listed below had been classified for either "restricted" or "general" use by the EPA. Additional insecticides are expected to be classified before the 1985 planting season. Some soil insecticides (Counter, Dyfonate, Furadan, Mocap, and Thimet) are expected to be classified before 1986.

The chemical names used in this circular may be unfamiliar to you. These names are the common, coined chemical names and as such are not capitalized (for example, terbufos). Trade names are capitalized (for example, Counter). In the table of limitations (Table 15), the trade names are listed first, with the common name in parentheses following the trade name. In the tables of suggestions, only the trade name is listed.

Table 1. Insecticide Classifications

Common name	Trade name	Classification
acephate	Orthene	unclassified
Bacillus thuringiensis	Dipel, Thuricide, Bactur, SOK	unclassified
carbaryl	Sevin	unclassified
carbofuran	*Furadan	restricted[a]
carbophenothion	Trithion	unclassified
chlorpyrifos	Lorsban	unclassified
diazinon	Diazinon	unclassified
dimethoate	Cygon	unclassified
disulfoton	*Di-Syston	restricted[a]
ethion	Ethion	unclassified
ethoprop	*Mocap	restricted[a]
fenvalerate	*Pydrin	restricted[b]
fonofos	*Dyfonate	restricted[a]
malathion	Cythion, malathion	unclassified
methidathion	*Supracide	restricted[b]
methomyl	*Lannate, *Nudrin	restricted[c]
methoxychlor	methoxychlor	unclassified
methyl parathion	*Methyl parathion	restricted[b]
methyl parathion (microencapsulated)	*Penncap-M	restricted[b]
permethrin	*Ambush, *Pounce	restricted[b]
phorate	Thimet	unclassified
phosmet	Imidan	unclassified
terbufos	Counter	unclassified
trichlorfon	Dylox	unclassified
trimethacarb	Broot	unclassified

[a] Liquid formulations are restricted.
[b] All formulations are restricted.
[c] All formulations except water-soluble packages, 25% wettable powder, and granulars are restricted.

Asterisks (*) are used throughout this circular to indicate insecticides classified for "restricted" use.

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN COLLEGE OF AGRICULTURE COOPERATIVE EXTENSION SERVICE
In cooperation with ILLINOIS NATURAL HISTORY SURVEY CIRCULAR 899 (revised annually) November, 1984

Special Local Need Registrations

Section 24(c) of the amendments to the Federal Insecticide, Fungicide, and Rodenticide Act of 1972 allows states the right to register pesticides for use within the state to meet special local needs (SLN). The authority for state registration of pesticides is the Illinois Department of Agriculture. A special label, which lists the new 24(c) uses, is printed by the formulator. A copy of this label must be in the possession of the operator during application of the pesticides.

POLICY STATEMENT

The *Illinois Insect Pest Management Guide: Field and Forage Crops* (Circular 899) is revised annually and is intended for use during the current calendar year only. Not all insecticides registered for crop pests are included in this circular. Insecticides that are effective and do not present an undue hazard to the user are suggested whenever possible.

Trade names have been used for simplicity, but their usage does not imply the endorsement of one product over another, nor is discrimination intended against any product.

This guide for insect control is based on research results from the Illinois Natural History Survey, the University of Illinois Agricultural Experiment Station, other experiment stations, and the U.S. Department of Agriculture.

Be sure to check with your county Extension adviser in agriculture if you are in doubt about an insecticide you plan to use. We will make announcements of new labels and changes in recommendations through the news media to keep you up to date.

REFERENCES

Fact sheets (designated by NHE numbers) discussing nonchemical control methods, descriptions of specific insects, and their life history and biology can be obtained from the office of the county Extension adviser in agriculture or by writing to Entomology Extension, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

PEST-MANAGEMENT SCOUTING PROGRAMS

Integrated Pest Management (IPM) and pest scouting have become increasingly important. IPM is a systematic method of looking for pests in the field, of determining whether any control measures are needed, and if there is a problem, of deciding on the proper measures to use. Pest scouting enables farmers to detect and control pest outbreaks before significant yield losses occur. Because decisions on chemical control are based on economic thresholds and not on guesswork, IPM programs also keep unnecessary pesticide use to a minimum.

Pest scouting has been accepted as an important management tool by many Illinois farmers in the past several years. As farming costs increase, growers are realizing the advantages of treating a field only when an economically harmful pest population occurs, rather than treating it automatically regardless of the situation. By using pesticides on this basis, farmers have a better chance of reducing management costs.

Pest scouting programs have been initiated by several pest-management consulting firms throughout the state. In addition to pest scouting, most offer other services such as soil testing and nematode monitoring.

PESTICIDE SAFETY

Certain precautionary steps should be taken when handling insecticides. The insecticides suggested in this publication can be poisonous to the applicator. The farmer or applicator is expected to protect himself, his workers, and his family from needless exposure.

When using insecticides, apply all the scientific knowledge available to make sure that there will be no illegal residue on the marketed crop. Such knowledge is condensed on the label. READ THE LABEL CAREFULLY AND FOLLOW THE INSTRUCTIONS. The label should be recent and not from a container several years old. Do not exceed the maximum rates suggested. Observe the interval between application and harvest. Apply only to crops for which use has been approved. Keep records of pesticide use for each field. Record the product used, the trade name, the percentage content of the insecticide, the dilution, the rate of application per acre, and the date or dates of application.

Always handle insecticides with respect. The person most likely to suffer ill effects from insecticides is the applicator. Accidents and careless, needless overexposure can be avoided. Following these rules will prevent most insecticide accidents:

1. Wear rubber gloves when handling insecticide concentrates.
2. Do not smoke, eat, or drink while handling or using insecticides.
3. Keep your face turned to one side when opening, pouring from, or emptying insecticide containers.
4. Leave unused insecticides in their original containers with the labels on them.
5. Store insecticides out of the reach of children, irresponsible persons, and animals; store preferably in a locked building. Do not store near livestock feeds. Better yet, buy no more pesticide than you will use, thus eliminating a pesticide storage and disposal problem.
6. Triple rinse, bury, or burn all empty insecticide containers or take them to an appropriate sanitary landfill.
7. Do not put the water-supply hose directly into the spray tank or blow out clogged nozzles or spray lines with your mouth.

8. Wash with soap and water exposed parts of the body and clothes contaminated with insecticides.

9. Do not apply to fish-bearing or other waters.

10. Do not leave puddles of spray on impervious surfaces or apply insecticides near dug wells or cisterns.

11. Do not apply insecticides, except in an emergency, to areas with abundant wildlife.

12. Do not spray or dust when weather favors drift.

13. To avoid bee kill, apply insecticides after bee activity has been completed for the day; use the least toxic materials. *Warn beekeepers that you are applying insecticides.*

Refer to the *Illinois Pesticide Applicator Study Guide* for more information concerning safe handling of pesticides and treatment of pesticide poisoning.

POTENTIAL FOR SOIL INSECT PESTS IN CORN

There are many factors that affect soil insect populations and their potential to damage corn. The type of crop rotation greatly influences whether a soil insect problem will occur and what kind it will be. Weather, weeds, soil type, planting date, hybrid, tillage, and natural enemies also influence insect populations. Knowledge about soil insect damage in a particular field during previous years is also helpful because infestations tend to occur in the same fields and in the same area.

Illinois Extension entomologists have estimated the probability of the occurrence of soil insect pests in corn on the basis of cropping sequence (Table 2). These estimates can serve as a guide to determine the risk of damage caused by soil insects and the need for applying a soil insecticide at planting.

Corn After Soybeans. The potential for soil insect problems in corn after soybeans is generally low, and the use of soil insecticides rarely pays. Corn rootworms rarely cause damage to corn after soybeans. In most fields, a diazinon + lindane planter-box seed treatment will be adequate to protect against attack by seedcorn beetles, seedcorn maggots, and wireworms. Scout the field for cutworm damage as the plants emerge from the soil.

White grubs are an occasional problem in east-central Illinois in corn after soybeans.

Corn After Corn. The potential for rootworm damage is moderate to severe wherever corn follows corn in Illinois. A rootworm soil insecticide may be needed in most fields of corn after corn. Wireworms are occasionally a problem in the southern part of Illinois. Scout for cutworm damage.

Corn After Grass Sod. Wireworms and white grubs are potential problems. Apply a labeled soil insecticide at planting time. Scout for cutworm damage.

Corn After Sorghum. A planter-box seed treatment of diazinon or diazinon + lindane will protect the corn seeds against seedcorn maggots. Scout the fields for cutworms as the corn emerges. Corn rootworms are rarely a problem where corn follows sorghum.

Corn After Legumes. Cutworms, grape colaspis, grubs, and wireworms occasionally damage corn planted after clover and alfalfa. In addition, adult northern corn rootworms are sometimes attracted to legumes or to blooming weeds in legumes for egg laying, particularly in years when beetles are forced to leave adjacent fields of drouth-stressed corn to seek food. A soil insecticide should be considered for this cropping sequence.

Corn After Small Grain. There is a slight potential for damage by wireworms, seedcorn beetles, and seedcorn maggots in corn after small grain, particularly wheat. In most instances, a diazinon + lindane planter-box seed treatment will be adequate. If wireworms are

Table 2. Probability Estimates of Economic Soil Insect Damage in Corn and Suggestions for Control According to Cropping Sequence, Illinois

Crop preceding corn	Insect pest							Need for a soil insecticide	Recommended pest management practices
	Wireworm	Cutworm	Corn rootworm	White grub	Seedcorn maggot	Billbug	Grape colaspis		
Soybeans	1:500	1:25	1:10,000	1:1,000	1:150	1:100	1:1,000	very low	Use planter-box seed treatment; scout for cutworms.
Corn	1:200	1:100	2:3	1:1,000	1:50	1:100	1:5,000	mod-high	Scout for rootworm beetles; treat corn if population exceeds 1 per plant at any time during August.
Small grain	1:100	1:50	1:100	1:250	1:50	1:200	1:5,000	low	Bait for wireworms prior to planting.
Legume	1:25	1:25	1:50	1:150	1:10	1:50	1:4	low-mod	Bait for wireworms prior to planting.
Grass sod	1:10	1:25	1:500	1:10	1:25	1:50	1:1,000	mod-high	Use soil insecticide for wireworms and white grubs; if no-till, scout for foliar insect damage as corn emerges.

present, use a soil insecticide at planting time. Excessive weed cover in small grain stubble fields may have been attractive to northern corn rootworm beetles for egg laying as the beetles moved from adjacent fields of drouth-stressed corn.

CORN ROOTWORM SITUATION

Problem Area

Populations of northern and western corn rootworm beetles were extremely high in 1984. Although the potential for rootworm damage to corn following corn is greatest in the northern two-thirds of the state, moderate to severe damage to corn roots by larvae may occur in any field where corn follows corn in Illinois.

Rootworm Soil Insecticide Failures, 1984

Corn rootworm larval control with soil insecticides was very erratic in Illinois during 1984, in both farmers' fields and research trials. Instances of poor control were observed with all rootworm soil insecticides, carbamates and organophosphates, over a wide geographical area with various soil types and weather conditions. An investigation of some of the problem fields has disclosed several factors that probably contributed to poor control with the insecticides. The factors that stand out but are not easily quantifiable include too much rain immediately following planting, dry soil conditions during June, a late rootworm egg hatch, above-average rootworm larval populations, and improper calibration of insecticide applications (rates that were too low).

In some fields, heavy rains immediately following planting hastened the decomposition of soil insecticides and reduced control. In others, lack of rain prevented the movement of the insecticide from the soil surface or off the granular carrier to the area where rootworm larvae were feeding. Early planting also may have been a contributing factor in some fields because soil insecticides applied in April or early May could have lost much of their potency by the time eggs hatched in mid-June. Hence late hatching larvae escaped the insecticide, resulting in extensive root damage and ultimately a large number of beetles. Undoubtedly, several of these conditions in combination could have affected the performance of soil insecticides.

Unfortunately the factors that influence the performance of soil insecticides under field conditions are not well understood. Recent research indicates that the breakdown of some soil insecticides by soil microorganisms is accelerated after repeated applications of the same compound. The soil microorganisms use the insecticide as an energy source, so their populations increase to a level where they are able to break down the insecticide very rapidly. As a result, the insecticide has a progressively shorter residual time in the soil. This seems to be most prevalent in fields where the same soil insecticide has been used for several consecutive years; however, the pattern is neither clearcut nor predictable. In all probability, environmental conditions combined with accelerated degradation of the insecticides by microorganisms are major causes for insecticide failures.

Are the rootworms more tolerant to the soil insecticides? Although this has not been confirmed, some research data suggest that some slight change in susceptibility has occurred with some compounds. Unfortunately most tests to detect resistance are conducted with the adult stage rather than the damaging larval stage. So at this point, tolerance to insecticides cannot be ruled out.

Determining Potential for Damage in 1985

Corn growers should base the need for using a rootworm soil insecticide in 1985 on the abundance of rootworm beetles in cornfields during late summer of 1984. If beetle numbers reached or exceeded one per plant at any time during late July, August, or September, 1984, plan to apply a rootworm soil insecticide if the field is to be replanted to corn in 1985.

Fields of corn planted in late May or June, 1984, may have extensive rootworm damage if replanted to corn in 1985. During August and September, rootworm beetles are especially attracted to late planted or late maturing fields. Seeking fresh pollen and silks to feed on, the beetles lay millions of eggs in these fields. Planting the fields to a crop other than corn in 1985 is suggested to reduce the rootworm population.

SUGGESTIONS FOR ROOTWORM CONTROL, 1985

In recent years, the performance of rootworm soil insecticides has been quite variable. They have performed effectively at some locations and have been marginal or ineffective at others. This trend could continue in 1985. An immediate solution to the phenomenon of erratic rootworm soil insecticide performance is not readily available. Perhaps there is none. It is entirely possible that changes brought about by treating millions of acres of corn with soil insecticides over the past 20 years have introduced an era when rootworm control with current soil insecticides will be highly variable.

Looking to 1985, you should seriously consider crop rotation, particularly in fields where there is a high probability of rootworm damage. Other alternatives include applications of a soil insecticide at planting or at cultivation. Considering the erratic performance of planting-time treatments in 1984, a cultivator application in early June near the beginning of rootworm egg hatch should be an effective option. However, for most farmers planting time treatments of a soil insecticide

will be the predominant method of rootworm control. If you use a soil insecticide at planting, plan to check fields in early to mid June to determine whether damage is occurring. If so, a cultivator application may be needed.

Crop Rotation

Crop rotation is an extremely effective way to prevent damage by northern and western corn rootworm larvae. If feasible, do not grow corn two years in succession in the same field. First-year corn following soybeans will generally not require a soil insecticide for rootworm control.

Although rootworm beetles can be found in "clean" or weed-free soybean fields, and may even lay a few eggs there, the number of eggs is not great enough to warrant the use of a soil insecticide on corn the following season. In a few instances, rootworm larval damage has occurred to corn planted after soybeans when the bean field had been heavily infested with volunteer corn or weeds during August. Adult northern and western corn rootworms were attracted to these weedy soybean fields to deposit eggs. As a result, root damage by larvae occurred the following season. Good weed control in soybeans will prevent rootworm damage in corn following soybeans. Soybean fields with 5,000 or more volunteer corn plants per acre will usually warrant treatment for rootworm control the following year if planted to corn.

Corn rootworm beetles deposit the vast majority of their eggs in cornfields. The larvae cannot survive on the roots of broadleaf crops (soybeans or alfalfa) or broadleaf weeds. Consequently, when a crop other than corn, soybeans for example, is planted in a field with soil containing millions of rootworm eggs, the rootworm larvae die before becoming egg-laying beetles.

Soil Insecticides

The suggestions for rootworm control that follow are based on research conducted by entomologists in Illinois and other states.

At Planting. Apply Broot 15GX, Counter 15G, Dyfonate 20G or 4EC, Furadan 15G or 4F, Lorsban 15G, Mocap 15G, or Thimet 20G in a 7-inch band at the suggested rate (see Table 3). IMPORTANT: Read the suggestions in the section on alternating rootworm soil insecticides.

Soil insecticides will give 50 to 70 percent control of corn rootworm larvae. This degree of control is adequate to prevent economic levels of larval damage in most fields. But in some heavily infested fields enough larvae may survive to cause economic levels of root damage, and beetle populations may be large enough to interfere with pollination.

Planting-time treatments applied in early April may provide only marginal control. Consider a cultivator application in late May or early June in such fields, rather than a treatment at planting time.

Liquid formulations. Dyfonate 4E or Furadan 4F may be mixed with water and applied as a spray in a 7-inch band ahead of the press wheel. They may also be mixed with liquid fertilizer and used with a split-boot applicator at planting.

Incompatibility or crop injury may be a problem in treatments using a liquid insecticide with a liquid fertilizer at planting. The insecticide *must* be compatible with the fertilizer. Conduct a test before planting to make certain that the two are physically compatible. Maintain agitation in the tank after mixing and during application to prevent separation. **Use caution when handling liquid insecticide formulations.**

At Cultivation. Apply Counter 15G, Dyfonate 20G, Furadan 15G or 4F, Lorsban 15G or 4E, Mocap 15G,

Table 3. Soil Insecticides Suggested for Rootworm Control, Illinois, 1985

Insecticide[a]	Time of application	Ounces of product per 1,000 ft. of row	Amount of product needed per acre			
			40″ rows	38″ rows	36″ rows	30″ rows
Broot 15GX	At planting	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
Counter 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
Dyfonate 20G	At planting or cultivation	6	5.0 lb.	5.3 lb.	5.6 lb.	6.7 lb.
*Dyfonate 4E	At planting	2.4 fl. oz.	2 pints	2⅛ pints	2¼ pints	2¾ pints
*Dyfonate 4E	Preplant	Broadcast	3 quarts	3 quarts	3 quarts	3 quarts
Furadan 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
*Furadan 4F	At planting or cultivation	2.4 fl. oz.	2 pints	2⅛ pints	2¼ pints	2¾ pints
Lorsban 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
Lorsban 4E	At cultivation	2.4 fl. oz.	2 pints	2⅛ pints	2¼ pints	2¾ pints
Mocap 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
Thimet 20G	At planting or cultivation	6	5.0 lb.	5.3 lb.	5.6 lb.	6.7 lb.

[a] Consult text for more information. LIQUID FORMULATIONS ARE HIGHLY TOXIC.
* Use restricted to certified applicators only.

or Thimet 20G on both sides of the row at the base of the plants just ahead of the cultivator shovels. Cover the insecticides with soil. The best time to apply a basal treatment of a soil insecticide by cultivator is in late May or early June, near the beginning of egg hatch.

A cultivation-time application of a soil insecticide is an alternative to a planting-time application or may be used as a "rescue" treatment if the planting-time insecticide fails to control rootworm larvae. In either case, you should dig up several plants and examine the roots and surrounding soil for rootworm larvae. If you find 3 or more larvae per plant, a cultivator application is warranted.

Soil moisture may affect both application and effectiveness of cultivation-time treatments. Fields that are too wet may never be cultivated. On the other hand, the insecticide may not perform satisfactorily if the soil is too dry.

Suggestions For Alternating Rootworm Soil Insecticides. Laboratory and field research indicates that using the same rootworm soil insecticide for several consecutive years can eventually lead to erratic, if not poor, rootworm control. This first became apparent in Illinois during the mid-1960s when northern and western corn rootworms developed resistance to aldrin and heptachlor, about 5 years after these compounds were first used in the field.

Buxten, a carbamate soil insecticide introduced in 1967, gave good rootworm control until the early 1970s, but was dropped from University of Illinois's recommendations in 1974 after problems with control had developed. Furadan, also a carbamate soil insecticide, was used by many farmers with excellent results from 1969 until 1975 when control became erratic. More recently, Amaze, an organophosphate that had provided excellent rootworm control in research trials, was removed from the soil insecticide market by the manufacturer following poor rootworm control in 1983 — only 3 years after being registered.

A lesson to be learned from the preceding scenario is that extensive and continuous use of any one compound may contribute to erratic results and to its eventual failure.

A review of the factors that might have contributed to erratic rootworm control in 1984 suggests that late egg hatch, dry soil during June and July, and intense population pressure were the causes. However, if there are other underlying factors, the scenario observed in 1984 may be repeated in 1985, but on a larger scale.

Illinois entomologists encourage growers to consider switching rootworm soil insecticides occasionally, rather than using one product for several consecutive years.

Consider the following suggestions for alternating rootworm soil insecticides:

1. If performance of a soil insecticide has been poor in a particular field in recent years, do not use the same insecticide in that field in 1985.

2. The continuous use of one insecticide may lead to a buildup of soil microorganisms that hasten the breakdown of an insecticide or to insect resistance. To avoid this possibility, consider switching rootworm insecticides occasionally rather than using one compound year after year.

3. Consider alternating organophosphate and carbamate soil insecticides. Keep in mind, however, that growers generally have had no advance warning of poor control where problems have occurred.

4. If a carbamate (Furadan, Broot) was used in 1984, switch to an organophosphate (Counter, Dyfonate, Lorsban, Mocap, Thimet) in 1985. Avoid using carbamates in consecutive years or in fields where performance has been unsatisfactory in past years.

5. In fields with a history of organophosphate use, the carbamates should perform satisfactorily. If the organophosphate gave poor or erratic rootworm control in 1984, consider switching to a carbamate.

Summary: Planning Your Rootworm Control Program

1. Alternate corn with another crop when possible, particularly in fields where rootworm beetles averaged 1 or more per plant last summer, or if the soil insecticide did not give effective rootworm control in 1984.

2. If you intend to grow corn after corn and rootworm beetles averaged 1 or more per plant last summer, apply a rootworm soil insecticide at planting time. Apply the rate suggested in Table 3 and consider our suggestions for alternating rootworm soil insecticides.

3. Consider a cultivation-time application of a rootworm soil insecticide if you intend to plant in early April or if your planting-time insecticide does not provide effective control.

4. Scout for rootworm beetles in July and August, 1985, to determine the potential for rootworm larval damage in 1986.

Scouting to Determine Rootworm Potential in 1986

The abundance of rootworm beetles in a cornfield in July and August is an excellent indicator of future rootworm problems. Corn growers can determine the potential for rootworm damage in 1986 by counting western and northern corn rootworm beetles from mid-July through August, 1985, in this way:

1. Make 3 or more counts for western and northern corn rootworm beetles at 7- to 10-day intervals between mid-July and late August in fields to be replanted to corn.

2. Examine 5 plants selected at random in each of 10 areas of the field. Count all of the western and

northern corn rootworm beetles on 50 plants each time. The counts take about 45 minutes in a 40-acre field.

3. As you approach a plant, move quietly to avoid disturbing the beetles. Count the beetles on the entire plant, including the ear tip, tassel, leaf surface, and behind the leaf axils.

4. Record the number of beetles you find per plant. If the average is more than one beetle per plant for any sampling date, plan to apply a rootworm soil insecticide in 1985. If average populations range from ½ to 1 beetle per plant, the probability of economic damage the following year is low, and a soil insecticide is likely to be unnecessary. If populations do not exceed an average of ½ beetle per plant for any sampling date, a soil insecticide will not be needed the following season.

Rootworm Life Cycle

Western and northern corn rootworm beetles deposit their eggs in the soil at the base of the corn plants or between rows during August and September. The eggs overwinter in the soil and begin hatching in late May. Egg hatch usually takes place over a period of 3 to 5 weeks. Consequently, in July and August all stages of the corn rootworm — egg, larva, pupa, and adult — may be found. The rootworm larvae feed on the roots of corn plants during June, July, and August. When a larva is fully grown (½ inch), it builds a cavity in the soil and goes into the pupal or resting stage. After 5 to 10 days, the beetle emerges from the soil. The development from egg hatch to adult emergence takes 27 to 40 days. After the females emerge from the soil and mate, 14 days or more elapse before they begin laying eggs. Rootworm beetles may deposit as many as 1,000 eggs; an average of 500 per female is probably common. Most egg laying in Illinois occurs after August 1.

CORN CUTWORMS

The occurrence and extent of cutworm infestations are difficult to predict each year. *Sandhill, dingy,* and *claybacked cutworms* all overwinter in Illinois as partially grown larvae, but their populations are seldom widespread. As a result, they cause damage early in the growing season in scattered areas. Sandhill cutworms are a problem in sandy areas almost every year. Dingy and claybacked cutworms occur more frequently in corn planted after sod or forage legumes than in other crop rotations.

Black cutworms do not overwinter in Illinois, so outbreaks are difficult to forecast. Infestations of black cutworm larvae arise from eggs laid by moths that fly into Illinois in the early spring. A statewide program of monitoring black cutworm pheromone traps provides information about the time and intensity of spring moth flights.

Certain factors favor black cutworm outbreaks. The most important factors may be late planting and preplant weed infestations. Fields that are tilled and planted late are more likely to develop a preplant weed infestation than fields that are planted early. These late-planted fields with weeds are more attractive to cutworm moths as a site on which to deposit their eggs.

Currently, two options are available for cutworm control: preplant or planting-time applications of soil insecticides to prevent damage and rescue treatments after the infestation appears.

Because of the uncertainty in predicting which fields will have light, moderate, or heavy infestations of cutworms, it may be more feasible to use rescue treatments for cutworm outbreaks rather than to use a preplant or planting-time treatment unnecessarily.

Based on the relatively low incidence of cutworm problems over the past 25 years, a grower may find an economic advantage to the wait-and-see system, which involves field scouting rather than a costly always-apply program in which the soil insecticide is routinely applied at or before planting for a problem that may not exist.

Rescue (or emergency) treatments to control outbreaks of cutworms include sprays of Ambush, Lorsban, Pounce, or Pydrin, or Sevin pelletized bait. Broadcast the pelletized bait on the surface, but do not incorporate. Ambush, Lorsban, Pounce, and Pydrin sprays should also be broadcast.

The keys to effective cutworm control with the rescue treatments are the amount of surface moisture and the movement of the worms. Control may be poor, regardless of the insecticide used, if the topsoil is dry and crusted and the worms are working below the soil surface. When the soil is dry, the high rate of Ambush, Lorsban, Pounce, or Pydrin is recommended.

To determine the need for rescue treatments, scout the fields during plant emergence, particularly those fields considered to be high-risk. Early detection of leaf-feeding or of cutting by cutworms is vital. When the corn plants are beginning to emerge, check the fields for leaf-feeding, cutting, wilting, or missing plants. Small cutworm larvae (less than ½ inch) feed on the leaves and do not begin cutting plants until they are about half grown.

A control measure is needed on corn in the 2-leaf stage if 3 percent or more of the plants are cut and if there are 2 or more cutworms per 100 plants. At the 4-leaf stage, control is justified if 3 percent or more of the plants are cut and if there are 4 or more worms per 100 plants. A single cutworm will cut fewer of the 4-leaf plants than those in the 2-leaf stage.

Planting-time treatments are relatively effective in controlling light to moderate infestations, but control may be unsatisfactory for heavy infestations. Lorsban 15G, Mocap 15G, Dyfonate 20G, Counter 15G, and Furadan 15G are registered for the control of cutworms in corn. Lorsban has provided the best cutworm control in research trials.

The Mocap label states that Mocap will "control light to moderate infestations of black and sandhill cutworms"; Dyfonate is labeled for "light and moderate infestations of black cutworms"; Counter and Furadan are labeled for "suppression of cutworms." Some growers may want to use one of these products in fields with a history of cutworm problems or in high-risk fields.

Preplant broadcast treatments of Lorsban 4E and Dyfonate 4E are also registered for corn cutworm control. Lorsban is labeled at rates of 1 to 2 quarts per acre; the higher rate is suggested. Dyfonate is labeled for "suppression of black cutworms" at 4 quarts per acre. Both insecticides should be incorporated into the top 2 to 4 inches of soil immediately after application.

Replanting may be required if cutworm damage is extremely severe. Before replanting apply Lorsban 4E as a broadcast spray at 3 to 4 pints per acre, and incorporate the insecticide into the top 2 to 4 inches of soil. Or you can apply a labeled granular insecticide. If the cutworm infestation is heavy, the Lorsban spray will be more effective.

WIREWORMS

Wireworms may attack the seed or drill into the base of the stem below ground level, damaging or killing the growing point. Damage will show up as wilted, dead, or weakened plants and spotty stands. Wireworm larvae are yellowish-brown and wirelike; several species are known to attack corn. They live for two to five years in a field in the larval stage, feeding on the roots of grasses and crops. Their presence is often related to the crops or weeds that were in the field two to four years before damage to the corn. Most reports of damage to corn have been in fields where corn follows soybeans or where there has been a corn-soybean-small grain rotation. The adult (a click beetle) prefers to deposit its eggs in small-grain stubble or in grassy fields.

Attempts to control wireworms with an insecticide rescue treatment after the damage appears are not very successful. Therefore, if an infestation is known to be present, an insecticide should be applied at planting.

Wireworms are usually most damaging in bottomlands or in poorly drained areas on upland soils. Low spots in the field often have the heaviest populations.

The proportion of fields of corn affected by wireworms in Illinois is small (less than 1 percent) and does not justify the widespread use of a soil insecticide on first-year corn after soybeans. A diazinon + lindane planter-box seed treatment may help deter the wireworms from attacking the seed but will not protect the seedling.

Checking for Wireworms

A technique using baits has been developed for evaluating wireworm potential before planting. The bait stations should be established 2 to 3 weeks before the anticipated planting date. Fields where small grain or grasses have been grown the preceding 2 or 3 years are the best candidates for bait stations.

Since wireworm infestations are usually not uniform within a field, it will be necessary to place the bait stations randomly throughout the field. One bait station per acre is desirable. As a minimum, place 2 stations at the highest elevation in a field, 2 on a slope, and 2 in the lowest area.

Follow this procedure for baiting:

1. Use a mixture of 1 cup of untreated wheat and 1 cup of untreated shelled corn at each station.
2. Bury the bait about 4 inches deep. It is also desirable to cover the ground over each bait station with an 18-inch square of black plastic. The plastic collects solar heat and speeds germination of the corn and wheat, which entices overwintering wireworms.
3. Mark each station with a flag or stake.
4. Dig up the bait stations in 10 to 14 days and count the number of wireworms.

Need for Treatment

If you find an average of one wireworm per bait station, use a labeled soil insecticide. In some instances, several wireworms may be found in one bait station and none in others. Wireworm infestations tend to concentrate in some locations. It may be possible to limit treatment to areas where the concentration is heaviest.

WHITE GRUBS

Several species of economically important white grubs have 3-year life cycles. Peak years of damage usually occur during the year following large flights of May beetles, the adult stage of white grubs. The beetles prefer to lay their eggs in ground covered with vegetation, such as weedy soybean fields and sod.

The C-shaped white grub larvae chew on the roots and root hairs of corn seedlings. During peak years of damage, the grubs feed all season long. Damage to a cornfield is most apparent in the spring. Symptoms of white grub injury visible aboveground are irregular emergence, reduced stands, and stunted or wilted plants. The damage is usually spotty throughout the field.

There are no effective rescue treatments for white grubs after the damage appears. However, if plants show symptoms of injury, dig around the root system of several corn plants. If white grubs are causing the problem and replanting is warranted, use a labeled soil insecticide.

PLANTER-BOX SEED TREATMENTS

Corn. Use a seed treatment in fields that do not receive a soil insecticide at planting time. A planter-box seed treatment with diazinon will protect germinating corn against attack by seedcorn beetles and maggots. A diazinon + lindane planter-box seed treatment protects

seed from attack by seedcorn maggots, seedcorn beetles, and wireworms. Lorsban 50-SL is labeled as a slurry treatment on seed before planting to protect germinating seed against injury by seedcorn maggots and beetles. NOTE: Excess dust from the seed treater may interfere with the electronic monitor in air planters.

Soybeans. Use a diazinon or diazinon + lindane seed protectant to prevent damage to germinating soybeans from seedcorn maggots. Follow the label directions for application. The potential for damage is greatest during cool, wet springs when germination is slow.

CALIBRATION FOR GRANULAR SOIL INSECTICIDES

Calibrate the applicators for granular soil insecticides before the planting season begins. In some instances, poor control is caused by applying rates that are too low. Proper calibration will help avoid this problem. Most soil insecticide bags have a list of suggested settings for the particular model of applicator. The settings are based on planting speed. The *beginning settings* are helpful, but be sure to check your actual application rate under your own operating conditions.

Follow these steps for calibrating the applicator:

1. Calibration of granular applicators for soil insecticides is usually based on ounces of product needed per 1,000 feet of row. Consult the insecticide label or Table 3 for labeled rates for rootworm control. These rates are expressed in ounces per 1,000 feet of row and in pounds of product per acre.
2. Consult the label or manufacturer's recommendation for an approximate application setting. Adjust the setting on each hopper.
3. Select an area for a test run, preferably in the field so that speed and traction conditions are constant. Measure off 1,000 feet.
4. Fill the hoppers and attach a plastic bag or container to each delivery tube to catch the granules from each hopper.
5. Drive the premeasured distance (1,000 feet) at the same speed to be used during the planting operation.
6. Weigh the material collected from each hopper. Use a scale that weighs in ounces (e.g., a postal scale or a diet scale).
7. Compare the quantity (ounces) per bag against those given in Table 3. To obtain one pound of active ingredient per acre the following amounts of material should be collected:

Formulation, percent	Oz. collected per 1,000 ft.
10	12
15	8
20	6

8. Recalibrate if the difference in quantity applied during the calibration process is more than 10 percent over or under the rate suggested on the label.

EUROPEAN CORN BORERS

Corn borer moths begin to emerge in late May in southern Illinois and mid- to late June in the central and northern regions. The females lay most of their eggs in the evening. They spend the daylight hours in fencerows and other protected areas.

First-generation borers reduce yields by stalk-tunneling, which weakens the plant and destroys the tissue used to transport food within the plant.

Corn that is planted early (the fields with the tallest corn) should be monitored closely from mid-June to early July for signs of whorl-feeding by corn borer larvae. The fields with the tallest corn in mid-June are the most attractive to moths laying eggs for the first generation. Control is warranted if 50 percent or more of the plants have fresh whorl-feeding and live borers are present. Seed production fields should be treated when 15 to 25 percent of the plants have whorl-feeding and larvae are present.

Corn hybrids have varying degrees of tolerance or resistance to leaf-feeding by first-generation borers. Consider this trait when selecting varieties for 1985.

Corn planted late is most attractive to moths laying eggs for the *second generation.* Yield losses caused by second-generation borers are a result of stalk breakage and ear drop, as well as physiological damage. Corn-borer entrance holes also provide avenues for stalk rot organisms. Monitor fields from mid-July to mid-August for egg masses or newly hatched larvae of the second brood.

To assess the potential for second-generation corn borers, start checking for egg masses when moth flight is under way. Examine a minimum of 25 plants, selected at random throughout the entire field, and count the number of egg masses that are found on each plant. Although the moths usually lay their eggs on the two or three leaves above or below the developing ear, you should check all the leaves. One technique is to remove the leaves one by one, starting at the bottom of the plant, and carefully scan them for egg masses.

The eggs, which are deposited in masses of 15 to 30, overlap like the scales of a fish. Calm nights favor egg deposition by the moths. The absence of hard, beating rains during moth emergence also increases the potential for infestations.

Egg masses are flat and about half the size of your little fingernail. Newly deposited eggs are white, then turn pale yellow, and become darker just before hatching. Eggs that are about to hatch have distinct black centers. These are the black heads of the larvae that are visible through the translucent eggshell. The eggs hatch in 3 to 7 days, depending on the temperature. The female moth hides in grass and weeds during the

day. Noncrop areas that border cornfields may harbor large numbers of corn borer moths during the day. Check these areas for moths as you enter the field to determine the potential for corn borer infestation.

Treatment is warranted when you find 1 egg mass for every two plants. Because peak egg laying generally occurs over a period of 2 to 4 weeks, it will be necessary to resample fields if egg masses are not present on half of the plants during the initial survey. If cumulative counts (taken 1 week apart) exceed 1 egg mass for every two plants, apply a treatment.

For best results, treatment should be applied soon after egg hatch to kill the young larvae before they bore into the plant. The larvae begin tunneling into the stalks about 10 days after hatching. Because egg laying for the second generation extends over a 3- to 4-week period, timing of insecticide application should be precise. Occasionally, two treatments may be necessary for satisfactory control.

CORN LEAF APHIDS

Corn leaf aphids are small, soft-bodied, greenish-blue plant lice about the size of a pinhead. They do not overwinter in Illinois. Winged corn leaf aphids, blown into Illinois on southwesterly winds during mid- to late June, become established within the whorl leaves of the corn plant. These aphids give birth to living young. In the absence of predators, parasites, diseases, and hard beating rains, aphid populations may increase very rapidly.

Corn leaf aphids cause damage by sucking moisture and nutrients from the corn plant. Soil moisture stress and heavy infestations on the upper leaves and tassel may result in barren plants or reduced ear size. The critical period for damage is during tassel emergence through pollination. If aphids are allowed to cover the tassel and upper two or three leaves, yield losses are likely to occur.

Fields should be scouted for aphids, beginning about one week before tassel emergence. Pull and unroll the whorl leaves of plants selected at random to check for aphids. Treatment is suggested if 50 percent of the plants have 100 or more corn leaf aphids per plant during tassel emergence and if *plants are under drouth stress.* Aphid populations usually decline after pollination is complete. However, treatment may be warranted following pollination if aphid populations continue to cover the tassel and one or two of the upper leaves.

REDUCED TILLAGE AND NO-TILL INSECT PESTS

Concern about insect problems should not keep growers from adopting conservation tillage practices. The soil-insect complex in corn, which is similar in many ways in conventional and reduced-tillage systems, can be readily controlled by applying soil insecticides at planting time. Outbreaks of insects feeding on foliage can usually be controlled with properly timed insecticide treatments. Close monitoring of fields to detect insect outbreaks is essential, regardless of the tillage system.

Weather conditions and the type of crop rotations determine to a great extent whether a soil insect problem will occur and what kind it will be. In some instances, tillage may also influence the kind and abundance of an insect pest. Some tillage operations favor specific pests. Others tend to reduce pest problems. The general expectation is that insect infestations will be more pronounced where no-tillage is used in corn than where conventional or reduced-tillage systems are used.

No-Till Pests

Insect problems occur more frequently in no-till corn than in any other conservation tillage system and are often more serious. Crop residue left by the use of no-till practices provides a stable environment for pest survival and development. Pests occurring under these conditions include *European corn borer, cutworms, armyworm, common stalk borer, wireworms, seedcorn maggots, billbugs, slugs,* and *mice.* Soil insecticides may be needed on no-till corn following corn (in rootworm area), grass sod, legumes, or following any crop in which grasses and broadleaf weeds are prevalent.

Soil Insect Control

Select a soil insecticide that will control the anticipated soil insect pest. Consult Table 5 for suggestions. If a soil insecticide is not applied at planting, a diazinon planter-box seed protectant will give protection against seedcorn maggots and seedcorn beetles.

Surface residues from no-till and reduced-tillage systems may present some problems with the placement and incorporation of granular soil insecticides applied at planting. To be most effective, the soil insecticide should be incorporated into the upper ½ inch of soil, and not just broadcast on the surface. Granules remaining on the soil surface are degraded by sunlight, resulting in erratic or poor control.

NOTE: Before using Broot, Dyfonate, Mocap, or Thimet on no-till corn, be sure that soil moisture is low enough to ensure closing of the seed furrow to prevent the insecticide granules from contacting the seed. Crop injury may occur with these products.

Aboveground Insect Pests

Aboveground insects will be more of a problem in no-till corn than under reduced or conventional tillage. Corn planted in grass sod or fall-seeded rye is vulnerable to attack by *armyworms.* The moths lay eggs on the grasses during April or early May. After vegetation is killed by a herbicide, the larvae move to the young corn

seedlings and feed on them. Control is justified when 25 percent of the plants are being damaged. Rescue treatments are effective, but a spray volume of 15 to 20 gallons per acre will improve coverage and control.

Instances of damage to corn by the *common stalk borer* have been greater in no-till corn than with other tillage systems. Moths of this insect deposit their eggs on weeds in late August and September. When a herbicide is applied in the spring to no-till corn in fields previously infested with host weeds, the newly hatched stalk borer larvae move from the dead vegetation and attack newly emerging corn plants. Rescue treatments may give erratic control of common stalk borer because the chemicals cannot reach the worms inside the stem. To reduce the potential of stalk borer damage in a subsequent season, it is essential to have good weed control within a field during August and September, when moths are laying eggs.

FORAGE INSECTS

Alfalfa weevils may cause moderate to severe damage to the first cutting of alfalfa in most areas of Illinois. In the southern counties, where a lot of egg laying takes place in the fall, alfalfa-weevil larval damage occurs early in the spring. Damage to the first cutting in northern Illinois is more likely to occur if hay harvest is delayed. Otherwise the injury to alfalfa in the northern counties will occur on the stubble and new growth of the second cutting.

Numbers of alfalfa weevils are regulated to a large extent by winter weather. During a cold, open winter the mortality rate is high in overwintering weevil populations; during mild winters the mortality rate is low.

A parasitic wasp and a fungal disease organism that attack alfalfa weevil larvae sometimes regulate weevil numbers in the spring. Although the wasp and the fungus will be present in alfalfa fields in 1985, we cannot yet predict their effect on weevil numbers.

Alfalfa growers in southern and central Illinois should inspect their fields closely in April, May, and June. Early larval damage appears as pinholes in the growing terminals. As the larvae grow, they skeletonize the leaves, and damaged fields appear tattered. Growers in northern Illinois should look carefully for larval damage in May and June. All growers should examine the stubble after the first cutting, because larval and adult feeding can slow or halt new growth. Follow the suggestions in Circular 1136, "Alfalfa Weevil Pest Management Program," to determine the need and proper timing of a treatment. If this circular is unavailable, a rule of thumb is to treat when 25 percent of the tips are being skeletonized. This threshold is 40 percent in northern Illinois where damage occurs later in the season.

Potato leafhoppers may cause moderate to severe damage to the second and third cuttings of alfalfa in all areas of Illinois. However, population levels are difficult to predict because the leafhoppers do not survive the winter in Illinois. They migrate from southern states into Illinois during May and June.

Damage first appears as a yellow, wedge-shaped area at the tip of the leaf and is more evident during dry weather. Many people confuse the damage with diseases or nutrient deficiency.

Damage may begin on the new growth as soon as the first hay crop is removed. Stunting and yellowing are signs of leafhopper injury. A swarm of leafhoppers at the time of the first cutting also indicates that there may be a problem in the new growth. The economic threshold for leafhoppers varies with the height of the alfalfa (see Table 4). A treatment is justified when the number of leafhoppers exceeds the economic threshold.

BEAN LEAF BEETLES

Bean leaf beetles overwinter as adults under debris in fencerows, wooded areas, and other protected sites. The survival of the overwintering beetles depends on the winter weather. A mild winter increases the chances for a large population in the spring. In addition, if soybeans are planted early, the beetles will establish themselves early. The availability of soybeans during the early part of the season is essential for the survival of bean leaf beetles. The survival of large numbers early in the season generally means an even larger population in August. On the other hand, a severe winter and later planted soybeans will reduce the number of bean leaf beetles in the spring.

The beetles may cause considerable leaf-feeding injury to double-cropped soybeans and late maturing soybean varieties. Insecticide treatments are recommended during the critical pod-set and pod-fill stages when defoliation exceeds 20 percent. The greatest concern, however, is caused by the beetles' pod-feeding damage, which leaves scars on many pods. These scars predispose the pods to fungal infections. A treatment is recommended when 5 to 10 percent of the pods are damaged.

Table 4. Economic Thresholds for Potato Leafhoppers on Alfalfa

Alfalfa height (inches)	Average number of leafhoppers per sweep of sweep net
0-3	0.2
3-6	0.5
6-12	1.0
12 or taller	1.5

CHEMICAL INJURY TO SOYBEANS

There have been instances of phytotoxicity to soybeans when organic phosphate soil insecticides were used. The problems have occurred where growers started planting soybeans without first emptying the insecticide boxes. Organic phosphate soil insecticides applied in soybean fields treated with Sencor or Lexone may cause injury to a soybean crop, according to information on the labels.

MANAGING INSECT PESTS IN STORED GRAIN

The following paragraphs describe methods for minimizing insect problems in stored grain. For more details on insecticides, rates, and methods of application, see Tables 11 and 12.

Remember that insect management for stored grain depends upon good grain storage practices. Store only clean, dry grain with a minimum of foreign material and a moisture content of 13 percent or less. Do not overfill bins; the levelled grain surface should be at least 8 inches below the lip of the bin. Grain should be cooled below 50°F as soon as possible. Do not mix new grain with old grain. If grain is to be stored one month or more between May and October, follow the procedures listed below.

New Grain (Wheat, oats, shelled corn, sorghum, barley, rye, and sunflower seed)

1. At least 2 weeks prior to filling, thoroughly clean in, around, and under the empty bin. Clean grain-handling equipment before harvest and collect the first few bushels coming through the combine to feed to livestock. Clean nearby seed storage areas, feed rooms, hay lofts, and other areas where insects may be present.

2. Two weeks before storage is to begin, spray the walls, ceiling, and floor of the bin to runoff with 2.0 percent malathion; use 4 ounces of the 50 to 57 percent EC per gallon of water. Be sure to thoroughly treat cracks and crevices, above doors, and behind false partitions. Malathion sprays will not successfully control insects in grain debris below nonremovable perforated subfloors. The fumigant chloropicrin (sold as Larvacide 100 and Quasar) will control insects in this subfloor void. Seal all openings at levels below the perforated floor, and close and seal all side doors and ventilation hatches. Pour in chloropicrin (32 ounces per 3,000-bushel bin) from a ventilation door on the bin roof. Post warning signs and wait 24 hours before airing out fumigated space.

Chloropicrin is a restricted-use pesticide.

3. Apply malathion to the grain as it is augered into the bin. Use 1 pint of malathion 50 to 57 percent EC in 2 to 5 gallons of water for each 1,000 bushels. An alternative to spray applications is to apply 10 pounds of 6 percent, 15 pounds of 4 percent, or 30 pounds of 2 percent malathion dust (wheat flour) per 1,000 bushels. Malathion treatments are effective for up to 12 months. Because high temperatures result in rapid volatilization and loss of malathion effectiveness, metered malathion applications at the auger are not recommended if grain is to be heat dried after it is in the bin.

4. In order to protect grain from Indian meal moth, which is resistant to malathion, follow either Step A or Step B.

Step A. Hang one dichlorvos resin strip per 1,000 cubic feet of overspace in enclosed bins and replace the strips every 6 to 8 weeks. Cover open-top bins with a raised tarp to retain the vapors from the dichlorvos resin strips.

Step B. An alternative to the dichlorvos strip is *Bacillus thuringiensis* (Dipel, Topside, SOK-BT). Apply it as a wettable powder (1 pound per 10 gallons of water) or liquid concentrate (4 pints per 10 gallons of water) at 0.6 pint finished spray per bushel to the top 4 inches of grain as it is augered into the bin. A dust formulation of *Bacillus thuringiensis* is available and should be applied at ½ ounce per bushel on the top 4 inches of grain as it is binned. Level the surface of the grain after treatment.

Although best results are obtained when the *B.t.* is applied to the grain as it is going into storage, *B.t.* can also be applied after the grain is binned. Apply one-third of the dosage over the entire surface and rake it in with a garden rake to a depth of 4 inches. Follow the same procedure for the second one-third of the dosage, and rake at a 90-degree angle to the first raking. Apply the last one-third over the surface and leave it undisturbed.

5. To protect grain from infestation by incoming insects other than Indian meal moth, spray the surface of the grain with malathion. Add 4 ounces of malathion 50 to 57 percent EC to 1 gallon of water. Apply at a rate of 2 gallons of finished spray per 1,000 square feet. An alternative is to apply malathion 6 percent dust at 5 pounds, the 4 percent dust at 7.5 pounds, or the 2 percent dust at 15 pounds per 1,000 square feet. Do not rake this treatment into the surface grain.

6. Cool the grain below 50°F as soon as possible. Stored grain insects do not reproduce at temperatures below 60°F, and they do not feed when grain temperatures drop below 50°F.

7. Inspect the grain at monthly intervals. Use probes to monitor temperature, moisture, and insect presence at several sites and depths.

Soybeans

Clean the bin and grain-handling equipment before harvest, and treat the walls, ceiling, and floor of the bin as suggested under "New Grain," Step 2. Soybeans

stored at safe moisture levels are attacked only by Indian meal moth. If soybeans are harvested before October 1 or carried over beyond May 15 of the following year, follow Step 4 under "New Grain." Aluminum phosphide can be used to fumigate soybeans if insect infestations are detected; check the fumigation instructions provided.

Infested Grain

Explore the option of cooling the grain below 50°F until you are ready to sell it or feed it to livestock. Also consider screening the grain and marketing it to avoid treatment costs. Weigh the loss due to a discount against the cost of control. Sometimes the most economical action is to immediately market infested grain.

Where only Indian meal moth infests stored grains, an alternative to fumigation is to use both the *Bacillus thuringiensis* and dichlorvos resin strip treatments as suggested in Step 4 under "New Grain." Fumigation is usually necessary if Indian meal moth infestations are severe.

Where infested grain can be moved to a clean and sprayed bin, treatment with malathion is an alternative to fumigation. Apply a spray of malathion to the grain as it is augered or elevated to the new bin. Use 1 pint of 50 to 57 percent malathion in 2 to 5 gallons of water for each 1,000 bushels. Although malathion will not immediately kill insects that are inside kernels, it will eventually provide effective control. Also follow Steps 4 through 7 as suggested under "New Grain."

Infested grain that cannot be handled as suggested should be fumigated. Bins with a capacity of more than 5,000 bushels should probably be treated by a licensed, professional fumigator. See your county Extension adviser in agriculture for a list of licensed fumigators.

To do your own fumigation, follow these steps:

1. Fumigate only on a calm, warm day when the grain temperature is above 70°F. Seal cracks and holes in the bin, paying particular attention to the base area around the doors and ventilating fan.

2. Level the surface of the grain, break up any caked or crusted areas, and remove webbing. The surface level of the grain should be at least 8 inches below the lip of the bin.

3. Spray the outside surface of the bin to runoff with a dilute spray of malathion. Mix 4 ounces of 50 to 57 percent malathion EC per gallon of water.

4. Apply a liquid or solid fumigant. (Methyl bromide, a gaseous fumigant, can be applied only by professional, licensed fumigators.) Use 3 to 5 gallons of liquid fumigant per 1,000 bushels; use the 5-gallon rate in wooden bins and flat storages. Common liquid fumigants are carbon bisulfide + carbon tetrachloride (80:20 mixture), and ethylene dichloride + carbon tetrachloride (75:25 mixture). Other liquid fumigants also may be available, but the use of formulations containing ethylene dibromide (EDB) for grain fumigation is now prohibited.

Place the containers on the grain surface, spacing them evenly. Loosen the caps slightly, then remove them, and invert the containers on the surface. *Get out of the bin within 30 seconds to one minute. Follow all directions and precautions on the label when using a fumigant. Wear protective clothing and a proper respirator. Have someone watching you from outside the bin as a safeguard.* It is better to apply the liquid fumigant uniformly over the surface as a coarse spray if you can do so from outside the bin.

Dry fumigants containing aluminum phosphide (including Phostoxin, Detia, Fumitoxin, and Gastoxin) may be used in place of liquid fumigants. A special applicator is required to place aluminum phosphide tablets or pellets in the grain mass. When handling the tablets or pellets, do not allow water to come in contact with them. Wear neoprene rubber gloves to prevent perspiration from coming in contact with the tablets or pellets. Following application, complete the process of sealing the bin by tarping the grain surface or tarping over the bin roof. Tarps may be partially in place prior to adding the aluminum phosphide to the grain. Although dangerous levels of phosphine gas usually do not develop above grain for 1 to 2 hours after treatment, this period can be much shorter if grain temperatures are high. Follow all label directions and precautions.

NOTE: Anhydrous ammonia is not suggested for fumigation of stored grains. It is generally ineffective against insects in stored grain unless concentrations exceed the level at which grain is blackened from exposure.

5. Place signs at all entrances warning that the bin is being fumigated. List the fumigant used and the name, address, and telephone number of a responsible person to contact in case of emergency.

6. Bins should remain sealed for 24 hours if liquid fumigants are used and 72 hours if aluminum phosphide is used. Air out bins before removing and disposing of liquid fumigant containers.

7. Protect against reinfestation by following steps 4 through 7 as presented under "New Grain."

Carry-Over Grain

Beginning about May 15 in the southern half of Illinois and June 1 in the northern half of the state, warming temperatures speed insect development and increase the risk of storage problems. Grain not treated with malathion within the past 12 months should be treated if grain transfer is possible. Use malathion as a protectant as directed in Step 3 under "New Grain." If grain transfer and treatment with malathion is not possible, monitor temperature, moisture, and insect presence twice per month from June to October. Where insects are detected, consider sale or fumigation and protection as previously discussed under "Infested Grain."

Table 5. Field Corn

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Armyworms	Furadan 15G	1[b]	Band, furrow	Apply as a planting-time treatment for armyworms in corn planted no-till in grass sod or small grains.
	*Ambush, *Pounce	0.1-0.2	Broadcast	At first migration, or when worms are eating leaves above ear level.
	Dylox	½-1		
	*Lannate, *Nudrin	¼-½		
	Lorsban 4E	½-1		
	malathion	1		
	*Penncap-M	½-¾		
	*Pydrin	0.1-0.2		
	Sevin	1		
Billbug	Counter 15G	1[b]	Band, furrow	At planting.
	Lorsban 15G	1-2[b]	Band	
	Lorsban 4E	2	Broadcast-PPI[c]	
	Lorsban 4E	1-1½	Broadcast	Apply as a postemergence rescue treatment with ground equipment when damage appears.
Chinch bug	Lorsban 4E	1[b]	Spray at base of plant	At start of migration from small grains. Use only ground equipment and apply 20 to 40 gallons of finished spray per acre.
	*Pydrin	0.1-0.2[b]		
	Sevin	2[b]		
Common stalk borer	Lorsban 4E	1-1½	Broadcast	Furadan 15G applied at 2-3 lb. a.i./acre at planting time may provide early season suppression of common stalk borers. Apply postemergence sprays when damage first appears. See labels for specific instructions about effective control.
	*Pydrin	0.15-0.2[b]		
Corn earworm	*Lannate, *Nudrin	½	Overall spray or directed toward ear zone	Justified only in seed corn fields. Several treatments may be needed. Insecticide applications are rarely effective for the control of earworms in commercial field corn after worms enter ear tips.
	*Pydrin	0.1-0.2		
Corn leaf aphid	Lorsban 4E	½-1	On foliage	Apply during late whorl to early tassel when 50% of plants have light to moderate infestations and plants are under drouth stress.
	malathion	1		
	*Penncap-M	½-¾		
Corn rootworm beetles	diazinon spray	½	Overall spray or directed toward ear zone	Before 75% of plants have silked, if there are 5 or more beetles per plant, and if silk clipping is observed. Only to protect pollination.
	Imidan	½		
	Lorsban 4E	½-1		
	malathion	1		
	*Penncap-M	½		
	Sevin	1		
Corn rootworm larvae	Broot 15GX	1[b]	Band	According to label directions, Mocap 15G should be applied behind the press wheels of all planters and then incorporated. For John Deere 7000 series planters, place Dyfonate 20G behind the firming wheels and incorporate. Do not place Broot, Dyfonate, Mocap, or Thimet in direct contact with the seed. Basal treatments during cultivation with Counter 15G, Dyfonate 20G, Furadan 15G or 4F, Lorsban 15G or 4E, Mocap 15G, or Thimet 20G are effective in late May or early June.
	Counter 15G	1[b]	Band	
	**Dyfonate 20G, 4E	1[b]	Band	
	**Furadan 15G, 4F	1[b]	Band	
	Lorsban 15G	1[b]	Band	
	Mocap 15G	1[b]	Band	
	Thimet 20G	1[b]	Band	
Cutworms	Lorsban 15G	1[b]	Band	Planting-time applications of Mocap 15G will control light to moderate infestations of black and sandhill cutworms. Dyfonate 20G applied at planting time will control light to moderate infestations of black cutworms. Counter 15G and Furadan 15G applied at planting time will suppress cutworms.
	Lorsban 4E	1-2	Broadcast-PPI[c]	
	*Ambush, *Pounce	0.1-0.2	Broadcast	Apply as a postemergence rescue treatment when 3 percent or more of the plants are cut in the 2-leaf stage and there are 2 or more cutworms per 100 plants. At the 4-leaf stage, control is justified if 3 percent or more of the plants are cut and there are 4 or more worms per 100 plants.
	Lorsban 4E	1-1½	Broadcast	
	*Pydrin	0.1-0.2	Broadcast	
	Sevin bait	1-2	Broadcast	
European corn borer, first generation	*Ambush, *Pounce	0.1-0.2	On upper ⅓ of plant and into whorl	When 50% or more of the plants have fresh whorl-feeding and live borers are present. Sprays are most effective when directed over the row, rather than broadcast.
	diazinon 14G	1		
	Dipel 10G	See label		
	Dyfonate 20G	1		
	**Furadan 15G, 4F	1		
	Lorsban 15G	1		
	*Penncap-M	1		

Table 5. Field Corn (continued)

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
European corn borer, second generation	diazinon 14G	1	On foliage	Apply at first hatch when half of the plants have egg masses, or when cumulative counts, made one week apart, exceed 1 egg mass for every 2 plants.
	Dyfonate 20G	1		
	**Furadan 15G, 4F	1		
	Lorsban 15G	1		
	*Penncap-M	1		
Fall armyworm	diazinon 14G	1	On foliage	Treat when 35% of plants have whorl damage and if worms are present. Ground sprays directed over the row are more effective than broadcast sprays. Treatments to control worms in ear tips are not effective.
	Dylox	1		
	*Lannate, *Nudrin	½		
	Lorsban 4E	1		
Flea beetles	diazinon spray	½[b]	Over row as spray	When leaves on seedling plants are severely damaged and some plants are being killed.
	Lorsban 4E	1[b]		
	*Penncap-M	½[b]		
	Sevin	1[b]		
Grasshoppers	Cygon	½	On foliage	As needed. The higher rates are suggested for control of adult grasshoppers.
	diazinon spray	½		
	*Furadan 4F	⅛-¼		
	Lorsban 4E	¼-½		
	malathion	1		
	*Penncap-M	¼-¾		
	*Pydrin	0.1-0.2		
	Sevin	½-1½		
Hop vine borer	None labeled	. .	. . .	Postemergence sprays of Pydrin or Lorsban may give some control if applied when damage first appears.
Japanese beetle	Sevin	1	On foliage	During the silking period to protect pollination if less than 75% of plants are silked and there are 3 or more beetles per ear.
Picnic, sap beetles	diazinon spray	1	On foliage	Justified only in seed corn fields when beetles are feeding on ear tips.
	*Lannate	½		
	malathion	1		
	Sevin	1		
Seedcorn beetles	Counter 15G	1[b]	Band, furrow	At planting.
	Dyfonate 20G	1[b]	Band	
	Lorsban 15G	1[b]	Furrow	
	Thimet 20G	1[b]	Band	
	diazinon	See label	On seed	Use formulations that are prepared as seed treaters.
	diazinon + lindane	See label	On seed	
	Lorsban 50-SL	See label	On seed	
Seedcorn maggots	Counter 15G	1[b]	Band, furrow	At planting.
	Dyfonate 20G	1[b]	Band	
	Furadan 15G	1[b]	Furrow	
	Lorsban 15G	1[b]	Furrow	
	Thimet 20G	1[b]	Band	
	diazinon	See label	On seed	Use formulations that are prepared as seed treaters. Seed treatments should be considered for fields that do not receive a soil insecticide at planting.
	diazinon + lindane	See label	On seed	
	Lorsban 50-SL	See label	On seed	
Sod webworm	None labeled	. .	. . .	At time of initial attack, sprays of Sevin or Lorsban may be effective.
Southwestern corn borer	diazinon 14G	1-2	On foliage	Direct granules over row. Apply when 25% of the plants have egg masses or larvae on leaves. Early-planted corn usually escapes damage. Sprays are most effective when directed over the row, rather than broadcast.
	Dyfonate 20G	1		
	**Furadan 15G, 4F	1		
	Lorsban 15G, 4E	1		
	*Penncap-M	1		
	*Pydrin	0.1-0.2		
Spider mites	diazinon spray	½	On foliage	Begin control if the majority of plants are infested with mites severe enough to cause some yellowing or browning of the lower leaves before dent stage.
	Di-Syston 15G[d]	1		
	ethion spray[d]	1		
	Thimet 20G[d]	1		
	Trithion	1		

Table 5. Field Corn (continued)

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Symphylans	Counter 15G	1[b]	Band, furrow	At planting.
	*Dyfonate 4E	2	Broadcast-PPI[c]	
	Lorsban 15G	1-1½[b]	Band	
	Lorsban 4E	1-2	Broadcast-PPI[c]	
Thrips	malathion	1	On foliage	When severe wilting and yellowing of leaves are noticed.
White grubs	Counter 15G	1[b]	Band, furrow	At planting. Furadan 15G applied in a 7-inch band or in the seed furrow will aid in the control of white grubs.
	Lorsban 15G	1-2[b]	Furrow	
	Lorsban 4E	2	Broadcast-PPI[c]	
	Thimet 20G	1[b]	Band	
Wireworms	Counter 15G	1[b]	Band, furrow	Dyfonate 20G applied in a 7-inch band is labeled for suppression of wireworms.
	Furadan 15G	1[b]	Band, furrow	
	Lorsban 15G	2[b]	Band, furrow	
	Lorsban 4E	2	Broadcast-PPI[c]	
	Mocap 15G	1[b]	Band	
	Thimet 20G	1[b]	Band	
Woollybear caterpillars	None labeled	. .	. . .	Silk clipping caused by caterpillars does not generally warrant control.

* Use restricted to certified applicators only.
** Liquid formulations of Dyfonate, Furadan, and Mocap are restricted.
[a] See Table 15 for insecticide restrictions.
[b] Based on 40-inch row spacing. Increase rates for narrow rows.
[c] PPI Pre-plant incorporated.
[d] To be applied only by experienced operators or those wearing protective clothing.

Table 6. Soybeans

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Bean leaf beetle	*Ambush, *Pounce	0.05-0.1	On foliage	Before bloom: when defoliation reaches 30%, at least 1 cotyledon per foot of row is destroyed, and there are 5 or more beetles per foot of row. Bloom to pod fill: when defoliation reaches 20% and there are 16 or more beetles per foot of row. Seed maturation: when 5 to 10% of the pods are damaged, the leaves are green, and there are 10 or more beetles per foot of row.
	Cygon	½		
	Lorsban 4E	½		
	Orthene	½		
	*Penncap-M	½		
	*Pydrin	0.1		
	Sevin	1		
Blister beetles	Sevin	1	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Corn earworm	*Ambush, *Pounce	0.1	On foliage	Damage occurs when larvae feed on pods. Apply control if populations exceed 1 per foot of row.
	*Lannate, *Nudrin	½		
	Orthene	1		
	*Pydrin	0.1-0.2		
Cutworms	Sevin bait	1-2	Broadcast	Scout as plants are emerging. Treat if 20% of plants are cut and stand has gaps of one foot or more and cutworms are present.
	Lorsban	1	Broadcast	
	*Pydrin	0.1-0.2	Broadcast	
Grasshoppers	Cygon	½	On foliage	When migration into fields begins and defoliation or pod feeding reaches economic levels. When defoliation reaches 30% before bloom and 20% between bloom and pod fill. The higher rates are suggested for control of adult grasshoppers.
	*Furadan 4F	⅛-¼		
	Lorsban 4E	¼-½		
	Orthene	¼-½		
	*Penncap-M	¼-¾		
	*Pydrin	0.1-0.2		
	Sevin	½-1½		

Table 6. Soybeans (continued)

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Green cloverworm	*Ambush, *Pounce	0.05-0.1	On foliage	When defoliation occurs during blooming, pod set, and pod fill. Usually requires 12 or more half-grown worms per foot of row and 20% defoliation to justify treatment.
	Dipel, Thuricide, Bactur, SOK (*Bacillus thuringiensis*)	See label		
	Lorsban 4E	½		
	Orthene	½		
	*Penncap-M	½		
	*Pydrin	0.05-0.1		
	Sevin	½		
Japanese beetle	*Penncap-M	¾-1	On foliage	When defoliation reaches 20% during bloom and pod fill.
	Sevin	1		
Loopers	*Ambush, *Pounce	0.05-0.1	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
	Orthene	½-1		
	*Pydrin	0.1-0.2		
	Thuricide, Dipel, Bactur, SOK (*Bacillus thuringiensis*)	See label		
Mexican bean beetle	*Ambush, *Pounce	0.05-0.1	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
	Cygon	½		
	*Furadan 4F	½		
	Lorsban 4E	½		
	Orthene	½		
	*Penncap-M	½		
	*Pydrin	0.05-0.1		
	Sevin	1		
Potato leafhopper	*Ambush, *Pounce	0.05-0.1	On foliage	When leafhoppers are numerous and the edges of the leaves appear burned.
	*Penncap-M	½		
	*Pydrin	0.05-0.1		
	Sevin	1		
Saltmarsh caterpillar	*Lannate, *Nudrin	½	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
	Lorsban 4E	½		
	*Pydrin	0.05-0.1		
Seedcorn maggot	diazinon	See label	On seed	At planting time. Use formulations that are prepared as seed treaters.
	diazinon + lindane	See label	On seed	
Spider mites	Cygon	½	On foliage	As needed on field margins or entire field.
	Lorsban 4E	½		
	*Penncap-M	½		
	Trithion	½-¾		
Stink bugs	Lorsban 4E	1	On foliage	When adult bugs or large nymphs reach 1 per foot of row during pod fill.
	Orthene	¾-1		
	*Penncap-M	½-¾		
	*Pydrin	0.1-0.2		
	Sevin	1-1½		
Thistle caterpillar	Sevin	2	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Thrips	*Penncap-M	½-¾	On foliage	If seedlings are being seriously damaged and some plants are being killed.
	Sevin	1		
Webworms	Sevin	1	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Whitefly	None labeled	. .	. . .	High infestations are occasionally present on double-crop soybeans, but are rarely economic.
Woollybear caterpillars	Lorsban 4E	½-1		When defoliation reaches 30% before bloom and 20% between bloom and pod fill. Sprays of Ambush or Penncap-M may also be effective.
	*Pounce	0.1		
	*Pydrin	0.1		

* Use restricted to certified applicators only. [a] See Table 15 for insecticide restrictions.

Spraying blossoming soybeans can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays.

Table 7. Alfalfa and Clover

Insect	Insecticide[a,b]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Alfalfa weevil (spring treatment for larvae)	*Furadan 4F	¼-½	On foliage	Refer to Circular 1136. Or when 25% of tips are being skeletonized and if there are 3 or more larvae per stem, treat immediately. Do not apply sprays during bloom. Instead, cut and remove the hay. Two treatments may be necessary on first cutting. Watch regrowth for signs of damage, and treat if feeding damage is apparent.
	Imidan	1		
	Lorsban 4E[c]	1		
	malathion + methoxychlor	2 qt. per acre		
	*Penncap-M	½		
	*Supracide	½		
	To avoid injury to bees, do not spray alfalfa during bloom or if weeds are blooming.			
Alfalfa weevil adults	*Furadan 4F	½-1		As a stubble spray.
	Imidan	1		
	Lorsban 4E[c]	1		
	*Penncap-M	¾		
Aphids	Cygon	¼	On foliage	When aphids average 100 or more per sweep and lady beetle larvae and adults, parasites, and diseases are not abundant.
	*Furadan 4F	¼		
	*Lannate	½		
	Lorsban 4E[c]	½		
	malathion	1		
	*Penncap-M	½		
	*Supracide	½		Avoid treatments when plants are blooming.
Blister beetles	Sevin	1	On foliage	Although blister beetles rarely cause economic damage to alfalfa, their presence in hay could injure horses if the horses ingest the beetles.
Clover leaf weevil	malathion	1	On foliage	When larvae are numerous (5 or more per crown) and leaf feeding is noticeable, usually in early to mid-April.
Cutworms	Dylox	1½	On foliage	As needed on regrowth of second cutting.
	Lorsban 4E[c]	1		
	Sevin	1½		
Fall armyworm	Dylox	1	On foliage	Usually in late summer or early fall on new seedlings or established stands.
	*Lannate, *Nudrin	½		
	Lorsban 4E[c]	1		
Grasshoppers	Cygon	¼-½	On foliage	When grasshoppers are small and before damage is severe. The higher rates are suggested for control of adult grasshoppers. Avoid treatments when plants are blooming.
	diazinon spray	½		
	*Furadan 4F	⅛-¼		
	Lorsban 4E[c]	¼-½		
	*Penncap-M	¼-¾		
	Sevin	1-1½		
Leafhoppers	Cygon	½	On foliage	Treatment is justified at these combinations of alfalfa height and leafhopper numbers:
	*Furadan 4F	½		
	Lorsban 4E[c]	½-1		
	*Penncap-M	½-¾		
	Sevin	1		
	*Supracide	½		

Alfalfa height (inches)	Leafhoppers per sweep
0-3	0.2
3-6	0.5
6-12	1.0
12 or taller	1.5

Avoid treatments when plants are blooming.

Plant bugs	Cygon	¼-½	On foliage	When tip damage is obvious and nymphs and adults are numerous.
	Dylox	1		
	*Furadan 4F	1		
	Lorsban 4E[c]	½-1		
	*Penncap-M	½-¾		
	Sevin	1		Avoid treatments when plants are blooming.
Spittlebug	Lorsban 4E[c]	½-1	On foliage	When spittle masses are found and nymphs average more than 1 per stem.
	malathion + methoxychlor	2 qt. per acre		
	malathion	1		Avoid treatments when plants are blooming.
	*Penncap-M	½-¾		

Table 7. Alfalfa and Clover (continued)

Insect	Insecticide[a,b]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Webworms	Dylox	1	On foliage	If damage appears.
	malathion + methoxychlor	2 qt. per acre		
	Sevin	1		

* Use restricted to certified applicators only. [a] See Table 15 for insecticide restrictions.
[b] Before applying insecticides, be certain to clean all herbicides out of equipment. During pollination, apply very late in day or, if possible, avoid application during bloom.
[c] Young, tender, rapidly growing alfalfa may show some phytotoxic symptoms when treated with Lorsban 4E.

Spraying blossoming alfalfa can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays.

Table 8. Grain Sorghum

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Chinch bug	Lorsban 4E[b]	1	At plant base	Use only ground equipment and apply 20 to 40 gallons of finished spray per acre.
	Sevin	2		
Corn earworm	*Lannate, *Nudrin	½	Over row	When there is an average of 2 worms per head.
	Sevin	1-2		
Corn leaf aphid	Cygon	¼-½	Over row	Corn leaf aphids rarely cause economic damage unless populations are heavy and drouth conditions exist.
	Lorsban 4E[b]	¼-½		
	malathion	1		
Cutworms	Lorsban 4E[b]	1	Broadcast	When seedling plants are being cut.
Fall armyworm	*Lannate, *Nudrin	½	Over row	When there is an average of 2 worms per head. Leaf feeding or whorl damage is seldom economic.
	Lorsban 4E[b]	1		
	Sevin	1½		
Grasshoppers	Cygon	½	Over row	As needed. The higher rates are suggested for control of adult grasshoppers.
	Lorsban 4E[b]	¼-½		
	Sevin	½-1½		
Greenbug	Cygon	¼-½	Over row	When greenbug damage is sufficient to cause death of more than 2 normal-sized leaves before the hard-dough stage. CAUTION: Some sorghum varieties are sensitive to organophosphate insecticides.
	diazinon spray	½		
	Lorsban 4E[b]	¼-½		
	malathion	1		
	Counter 15G	1-2[c]	Band	At planting.
	Furadan 15G	1[c]	Band, furrow	
	Thimet 20G	1[c]	Band	
Sorghum midge	Cygon	¼	Over row	Apply during bloom when 50% of heads have begun to bloom and there are 1 or more midge adults (flies) per head.
	diazinon spray	¼		
	*Lannate, *Nudrin	¼		
	Lorsban 4E[b]	¼		
Webworms	*Lannate, *Nudrin	½	Over row	When 5 or more larvae per head are found.
	Lorsban 4E[b]	1		
	Sevin	1-2		
Yellow sugarcane aphid	Cygon	½	Over row	Treatment should be applied at first sign of damage to seedling sorghum; 5 to 10 aphids per leaf.
	Lorsban 4E[b]	½-1		

* Use restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.
[b] To avoid phytotoxicity, do not treat plants that are under extreme heat and drouth stress.
[c] Based on 40-inch row spacing. Increase rates for narrow rows.

Table 9. Small Grains (Barley, Oats, Rye, Wheat)

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Armyworm	Dylox	½-1	On foliage	When there are 6 or more armyworms per linear foot of row and before extensive head cutting occurs. Do not use Dylox or Penncap-M on rye.
	*Lannate, *Nudrin	¼-½		
	*Penncap-M	½-¾		
	Sevin	1		
Fall armyworm	Dylox	1	On foliage	During fall when damage to new growth is apparent. Do not use Dylox on rye.
	Sevin	1-1½		
Grasshoppers	Cygon	⅜	On foliage	During fall when damage is apparent, treat field borders and noncrop areas to stop migration. The higher rates are suggested for control of adult grasshoppers. Do not apply Penncap-M to rye.
	*Furadan 4F	⅛-¼		
	malathion	1		
	*Penncap-M	¼-¾		
	Sevin	½-1½		
Greenbug, English grain aphid, oat bird-cherry aphid	Cygon	¼-⅜	On foliage	Aphids damage plants indirectly by transmitting disease. Once yellowing is noticeable, it is usually too late to treat. Use Cygon on wheat only. Do not apply Penncap-M to rye.
	malathion	1		
	*Penncap-M	¼-½		
Variegated cutworm	Dylox	1		As needed. Do not use Dylox on rye.
Wheat stem maggot	None	..	...	No chemical control. Damage shows as white heads when field is still green.

* Use restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.

Table 10. Grass Pasture

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Armyworms	Dylox	1	On foliage	As needed. Sevin and Dylox may be applied without removal of grazing livestock.
	malathion	1¼		
	*Penncap-M	½-¾		
	Sevin	1		Do not apply when weeds are blooming.
Grasshoppers	diazinon spray	½	On foliage	As needed. The higher rates are suggested for control of adult grasshoppers.
	malathion	1		
	*Penncap-M	¼-¾		
	Sevin	½-1½		Do not apply when weeds are blooming.

* Use restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.

Table 11. Stored Grain (Corn, Wheat, Oats)

NOTE: Corn, sorghum, and sunflower seed need not be treated if harvested after October 1 unless they are to be carried over after May 15 the following year. Wheat, oats, barley, and rye should be treated if they are to be held for one month or more in storage after harvest.

Insect	Insecticide and dilution	Dosage	Placement	Suggestions
Angoumois grain moth (earcorn)	malathion 57% E.C. 4 oz. per gal. water	Apply to runoff	Spray surface and sides about May 1 and August 1	Plant tight husk varieties. Store as shelled corn to avoid all but surface damage by Angoumois grain moth.
Indian meal moth				Clean and spray bin with 2.0% malathion to runoff before storage. Store only clean, dry grain. Where infestations develop, remove webbing before treating.
	dichlorvos 20% (DDVP, Vapona) plastic resin strip	1 strip per 1,000 cubic feet of space above grain mass	Attach to ceiling or side wall	Install at storage or by May 15. Replace every 6-8 weeks between May and October. Strips are effective only in enclosed bins; they will control adult moths, not eggs or larvae. Complete control requires 3-6 weeks. Fumigate if immediate control is necessary. Dichlorvos strips are also registered for use in bins containing soybeans.
	Bacillus thuringiensis dust 4,000 units per mg.	½ oz. per bu. (See Table 12)	Apply to top 4 inches of grain	*Bacillus thuringiensis (B.t.)* controls only larvae; it must be ingested. Formulations include Dipel, Topside, and SOK-BT. Control may require 3-6 weeks. Apply to grain as it is augered into bins or incorporate by raking once grain is stored. To rake in, apply ⅓ of total amount and rake in 4 inches deep; then apply another ⅓ of the total rate and rake at right angles to initial incorporation. Apply final ⅓ to the surface without raking. *B.t.* also is registered for use in soybeans.
	Bacillus thuringiensis WP 16,000 units per mg. 1 lb. in 10 gal. water	0.6 pt. per bu. (See Table 12)	Apply to top 4 inches of grain	
	Bacillus thuringiensis LC 4,000 units per mg. 4 pt. in 10 gal. water	0.6 pt. per bu. (See Table 12)	Apply to top 4 inches of grain	
GENERAL Internal and external feeders				Clean and spray bin with 2.0% malathion to runoff before storage. Store only clean, dry grain.
Rice and granary weevils Flat grain beetle Saw-toothed grain beetle Rusty grain beetle Foreign grain beetle Cadelle beetle	malathion 57% E.C. 1 pt. per 2-5 gal. water	2-5 gal. per 1,000 bu.	Spray uniformly as grain is binned. After binning apply 2 gallons per 1,000 square feet over the surface.	Do not apply malathion prior to heat-drying of grain, because high temperatures cause rapid malathion vaporization and loss of effectiveness. Malathion will not control Indian meal moth.
Flour beetles	malathion 6% wheat flour dust malathion 4% wheat flour dust malathion 2% wheat flour dust	10 lb. per 1,000 bu. 15 lb. per 1,000 bu. 30 lb. per 1,000 bu.	Apply over grain in combine hopper or uniformly as grain is binned. After binning, apply 5 pounds of 6%, 7.5 pounds of 4%, or 15 pounds of 2% per 1,000 square feet over the surface.	
	Fumigants:			Use extreme caution and follow all label directions when handling fumigants. Seal bin openings below the grain surface before fumigating. Grain surface should be level and at least 8 inches below the lip of the bin.

Table 11. Stored Grain (Corn, Wheat, Oats) (continued)

Insect	Insecticide and dilution	Dosage	Placement	Suggestions
GENERAL (continued)	Liquids (Carbon bisulfide plus carbon tetrachloride and ethylene dichloride plus carbon tetrachloride are common liquid fumigants.)	3-5 gal. per 1,000 bu.	On surface; repeat if necessary.	Apply under calm conditions when grain temperature is at least 70°F. Air out the bin 24 hours after fumigant application.
	*Aluminum phosphide (including Phostoxin, Detia, Fumitoxin, and Gastoxin)	180 tablets or 300 pellets per 1,000 bu.	Uniformly throughout	Apply when grain temperature is at least 60°F. After application, cover the grain surface with plastic tarp and seal the tarp to bin walls. Leave the bin sealed for 3 days, then air out.
	* Methyl bromide (gas)	20 lbs. per 10,000 bu.	Inject	METHYL BROMIDE IS TO BE APPLIED ONLY BY LICENSED, PROFESSIONAL FUMIGATORS.

* Use restricted to certified applicators only.

Table 12. Amount of *Bacillus thuringiensis (B.t.)* to Apply

Bin diameter (feet)	Bushels in top 4 inches of grain	Amount of *B.t.* wettable powder (lb.) and water (gal.) needed	Amount of *B.t.* liquid concentrate (oz.) and water (gal.) needed	Amount of *B.t.* dust (oz.) needed
8	13	0.1/1	6.5/1	6.5
12	30	0.25/2.5	14.5/2.5	15
16	53	0.4/4	26/4	27
20	84	0.6/6	39/6	42
24	120	0.9/9	58/9	60
28	163	1.25/12.5	80/12.5	82
32	214	1.6/16	103/16	107
36	336	2.5/25	160/25	168
40	415	3.1/31	198/31	208
48	478	3.6/36	230/36	239

Table 13. Noncrop Areas

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Grasshoppers	diazinon spray malathion *Pydrin Sevin	½ 1 0.05-0.1 ½-1½	On foliage	When grasshopper nymphs average 15 to 20 per square yard along roadsides and fence rows. The higher rates are suggested for control of adult grasshoppers. Do not spray areas adjacent to water or where runoff is likely to occur. Apply treatments while hoppers are small and before they migrate into row crops.

* Use restricted to certified applicators only. [a] See Table 15 for insecticide restrictions.

Table 14. Sunflowers

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Armyworm	Sevin	1½-2	Over row	When defoliation reaches 25%.
Cutworms	Sevin Lorsban 4E	1½ 1-1½	Over row	When 10% of the seedlings are damaged.

Table 14. Sunflowers (continued)

Insect	Insecticide[a]	Pounds of active ingredient per acre	Placement	Timing of application, comments
Fall armyworm	Sevin	1½-2	Over row	When defoliation reaches 25%.
Grasshoppers	*Furadan 4F	⅛-½	Over row	When defoliation reaches 25%.
	Lorsban 4E	½		
	Sevin	1-1½		
Stem weevil	*Furadan 4F	½	Over row	When there are 2 or more beetles per plant.
	Lorsban 4E	½-¾		
	Sevin	1-2		
	*Supracide	½		
Sunflower beetle	*Furadan 4F	⅛-¼	Over row	When defoliation reaches 25%.
	Lorsban 4E	½-¾		
	Sevin	1-2		
Sunflower moth larvae	*Furadan 4F	½	Over row	Apply first treatment when a field has reached 20 to 25% bloom and moths are present.
	Lorsban 4E	½-¾		
	*Supracide	½		

* Use restricted to certified applicators only. [a] See Table 15 for insecticide restrictions.

Spraying blossoming sunflowers can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays.

Table 15. Limitations in Days Between Application of the Insecticide and Harvest of Crop and Restrictions on Use of Insecticides for Field Crop Insect Control (These are only guidelines — read the label for more detailed information)

(Blanks denote that the product may not be labeled or suggested for that specific use in Illinois)

	Worker re-entry time (days)[a]	Field corn		Grain Sorghum	Forage crops		
		Grain	Ensilage		Alfalfa	Clover	Pasture
*Ambush (permethrin)[a,b]	...	A	A	...	...	...	...
Broot (trimethacarb)	...	90	90	...	...	...	...
Counter (terbufos)	...	B	30,C	D	...	...	...
Cygon (dimethoate)[b]	...	14,E	14,E	28,E	10,F	...	...
Diazinon	...	B	10	7	7	7	0
Dipel (*Bacillus thuringiensis*)	...	B	B	...	...	...	...
**Di-Syston (disulfoton)[a,b]	...	40	40	...	...	...	...
**Dyfonate (fonofos)	...	30	30	...	...	...	...
Dylox (trichlorfon)	...	G	G	...	0,G	0,G	0,G
Ethion	1	50,H	50,H	...	...	...	...
**Furadan (carbofuran)[a,b]	14[c]	30,I,J	30,I,J	75	K	...	...
Imidan (phosmet)	...	14	14	...	7,F	...	...
**Lannate (methomyl)[a,b]	...	B	3	14	7	...	...
Lorsban (chlorpyrifos)	...	35,L	14,L	60,M	21,N	...	...
Malathion	...	5	5	7	0	0	0
Methoxychlor	...		...	...	7	7	...
**Mocap (ethoprop)	...	B	B	...	...	...	...
**Nudrin (methomyl)[a,b]	...	B	3	14	7	...	...
*Penncap-M (microencapsulated methyl parathion)[a,b]	...	12	12	...	15	...	15
*Pounce (permethrin)[a,b]	...	A	A	...	...	...	...
*Pydrin (fenvalerate)[a,b]	...	21,P	21,P	...	...	...	...
Sevin (carbaryl)	...	0	0	21	0	0	0
*Supracide (methidathion)[a,b]	2	...	...	...	10,Q	...	...
Thimet (phorate)	7	30,R	30,R	...	...	...	...
Trithion (carbophenothion)[a,b]	...	B	21,S	...	...	...	...

Table 15. Limitations (continued)

	Worker re-entry time (days)[a]	Barley	Oats	Rye	Wheat	Soybeans	Sunflowers
*Ambush (permethrin)[a,b]	. . .	. . .	. . .	. . .	. . .	21,T	. . .
Cygon (dimethoate)[b]	. . .	. . .	. . .	. . .	60	21	. . .
Dipel, Thuricide, Bactur, SOK (*Bacillus thuringiensis*)	. . .	. . .	. . .	. . .	. . .	0	. . .
Dylox (trichlorfon)	. . .	21	21	. . .	21	. . .	. . .
**Furadan (carbofuran)[a,b]	14[c]	U	U	. . .	U	21,V	28,W
**Lannate (methomyl)[a,b]	. . .	7	7	7	7	14	. . .
Lorsban (chlorpyrifos)	. . .	. . .	. . .	. . .	. . .	28,X	42,Y
Malathion	. . .	7	7	7	7	0	. . .
**Nudrin (methomyl)[a,b]	. . .	7	7	7	7	14	. . .
Orthene (acephate)	. . .	. . .	. . .	. . .	. . .	14,Z	. . .
*Penncap-M (microencapsulated methyl parathion)[a,b]	. . .	15	15	. . .	15	20,AA	. . .
*Pounce (permethrin)[a,b]	. . .	. . .	. . .	. . .	. . .	21,T	. . .
*Pydrin (fenvalerate)[a,b]	. . .	. . .	. . .	. . .	. . .	21,BB	. . .
Sevin (carbaryl)	. . .	. . .	. . .	. . .	21,CC	0	60
*Supracide (methidathion)[a,b]	2	. . .	. . .	. . .	. . .	. . .	50,Z
Trithion (carbophenothion)[a,b]	. . .	. . .	. . .	. . .	. . .	7,Z	. . .

Read the label for more detailed information.

A. Apply prior to ear formation.

B. No specific restriction when used as recommended.

C. Only 1 postemergence incorporated treatment or 1 cultivation-time treatment may be used in addition to treatment at planting time.

D. Only one application per year may be used.

E. Make no more than 3 applications per year.

F. Apply only once per cutting; do not apply during bloom.

G. Three applications may be made per season on corn, and 3 applications may be made per cutting of alfalfa or grasses. Can be applied up to harvest.

H. Do not make more than 1 application after ear formation. Do not feed treated foliage to livestock.

I. Do not make a foliar application if Furadan 15G was applied at more than 8 ounces per 1,000 linear feet of row (6.7 pounds per acre with 40-inch row spacing) at planting. Do not make more than 2 foliar applications of Furadan 15G per season.

J. Do not make more than 2 applications of Furadan 4F per season at the 1½-2 pint use rate. Do not make more than 4 applications per season at the 1 pint use rate. Do not apply on seed corn less than 14 days prior to detasseling or rogueing. If prolonged, intimate contact will result, do not reenter treated field within 14 days of application without wearing proper clothing.

K. Make no more than 2 applications per season. Do not apply more than once per cutting. Do not use more than 1 pint per acre in the second application. Apply only to fields planted to pure stands of alfalfa. When using no more than ¼ pound per acre, allow 7 days between application and harvest. When using ¼ to ½ pound per acre, allow 14 days between application and harvest. When using ½ to 1 pound per acre, allow 28 days between application and harvest. Do not move bees to alfalfa fields within 7 days of application.

L. For soil insect control, do not exceed the equivalent of 16 ounces of Lorsban 15G per 1,000 feet of row or 13.5 pounds of Lorsban 15G per acre per crop season. For foliar insect control, do not exceed the equivalent of 16 ounces of Lorsban 15G per 1,000 feet of row or 13 pounds of Lorsban 15G per acre per crop season. Do not apply more than a total of 15 pints of Lorsban 4E per acre per season. Do not allow livestock to graze in treated areas nor harvest treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

M. The treated crop is not to be used for forage, fodder, hay, or silage within 30 days after application of 1 pint of Lorsban 4E per acre or within 60 days after application of rates above 1 pint per acre. Do not treat sweet varieties of sorghum. Do not apply more than 3 pints of Lorsban 4E per acre per season.

N. Do not apply more than once per cutting. Do not cut or graze treated alfalfa within 14 days after application of 1 pint of Lorsban 4E per acre, nor within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per year.

P. Do not exceed 1.0 pound of active ingredient per acre per season.

Q. Make no more than 1 foliage and 1 stubble application per alfalfa cutting.

R. Do not make more than one application over the plant.

S. Do not make more than one application per season.

T. Do not feed or graze livestock on treated plants. Do not exceed 0.8 lb. a.i. per acre per season.

U. Apply before heads emerge from boot. Do not make more than 2 applications per season. Do not feed treated forage to livestock.

V. Do not use Furadan 4F as a foliar application if Furadan 10G, Furadan 15G, Furadan 4F was applied to soybeans at planting time. Do not make more than 2 foliar applications per season. Do not graze or feed foliar-treated forage to livestock or cut for silage or hay.

W. No more than 4 applications per season.

X. Do not apply more than 6 pints of Lorsban 4E per acre or 3 pounds of chlorpyrifos (active ingredient) per acre per season. Do not apply last 2 treatments closer than 14 days apart. Do not allow livestock to graze in treated areas nor otherwise feed treated soybean forage to meat or dairy animals within 14 days after application. Do

Table 15. Limitations (continued)

not feed straw from treated soybeans to meat or dairy animals within 28 days after application. On determinate soybeans do not apply more than one application after pod set.

Y. Do not apply more than 9 pints of Lorsban 4E per acre per season. Do not allow livestock to graze in treated areas.

Z. Do not graze or feed treated crop to livestock.

AA. Do not make more than 2 applications per season.

BB. Do not feed or graze livestock on treated plants. Do not exceed 0.8 pound active ingredient per acre per season.

CC. Do not make more than 2 applications after grain heads emerge from boot.

* Use restricted to certified applications only.

**Liquid formulations are restricted.

[a] Workers should be warned in advance of treatments. Workers may not enter fields treated with the insecticides without wearing protective clothing for the intervals indicated. They may not enter a field treated with other insecticides without protective clothing until the spray has dried or the dust has settled. Protective clothing includes a hat, long-sleeved shirt, full length pants, and shoes and socks.

[b] Sprays to be applied only by experienced operators wearing proper protective clothing.

[c] Do not apply Furadan 4F on seed corn less than 14 days prior to detasseling or rogueing. If prolonged intimate contact will result, do not reenter field treated with Furadan 4F within 14 days of application without wearing proper protective clothing.

Table 16. Relative Toxicities of Commonly Used Agricultural Insecticides

		Toxicity to mammals[a]		Toxicity to		
Trade name	Chemical name	Acute oral	Acute dermal	Birds	Fish	Bees
*Ambush	permethrin	low	low	low	very high	high
Broot	trimethacarb	moderate	low	. . .	. . .	. . .
Counter	terbufos	high	high	high	very high	. . .
Cygon	dimethoate	moderate	moderate	moderate	very low	high
Diazinon	diazinon	moderate	moderate	high	high	high
Dipel, Bactur, Topside, Thuricide, SOK	*Bacillus thuringiensis*	very low	very low	very low	very low	very low
**Di-Syston	disulfoton	high	high	moderate	. . .	moderate
**Dyfonate	fonofos	high	moderate	moderate	. . .	. . .
Dylox	trichlorfon	low	low	low	very low	low
Ethion	ethion	high	high	low	. . .	very low
**Furadan	carbofuran	high	moderate	moderate	moderate	high
Imidan	phosmet	moderate	low	low	. . .	high
**Lannate, **Nudrin	methomyl	high	moderate	low	. . .	high
Lorsban	chlorpyrifos	moderate	moderate	moderate	very high	high
Malathion	malathion	low	low	low	moderate	high
Methoxychlor	methoxychlor	low	low	very low	very high	low
*Methyl parathion	methyl parathion	high	high	moderate	very low	high
**Mocap	ethoprop	moderate	high	moderate	. . .	moderate
Orthene	acephate	moderate	moderate	moderate	low	high
*Penncap-M	microencapsulated methyl parathion	moderate	low	moderate	very low	high
*Pounce	permethrin	low	low	low	very high	high
*Pydrin	fenvalerate	moderate	low	low	very high	very high
Sevin	carbaryl	low	low	very low	very low	high
*Supracide	methidathion	high	moderate	moderate	high	high
Thimet	phorate	high	high	moderate	very high	moderate
Trithion	carbophenothion	high	high	high	very high	moderate

* Use restricted to certified applicators only.

** Liquid formulations are restricted.

[a] Relative toxicities based on acute oral and acute dermal LD_{50} values of technical insecticide. Toxicities of formulated materials vary.

Always read the label before applying insecticides.

NOTES

NOTES

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